

E-DRIVE MANUAL

0001-0061

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1.0 INTRODUCTION

This manual contains information on the installation, operation and troubleshooting of the E-Drive adjustable motor speed control.

1.1 GENERAL DESCRIPTION

The E-Drive adjustable speed control is a dual-mode, speed control and drive for DC permanent magnet and shunt-wound motors up to two horsepower. The E-Drive utilizes digital closed-loop feedback techniques and a phase-fired SCR output.

1.2 DUAL MODE OPERATION

The E-Drive permits both manual and follower modes of operation. In manual mode, the speed setpoint is set by the speed potentiometer. In the follower mode, the potentiometer adjusts the ratio between the two motors. There is great flexibility in choosing the range and type of pulse generators on the lead and follow motors.

1.3 SPECIFICATIONS

Speed Range	20:1 (100 to 2000 RPM)
Control Accuracy	0.1% of Base Speed, Load Regulation
Load Response Time	Field Adjustable
Accel/Decel Time	Field Adjustable
Motor Loads	0 to 90VDC, 1 horsepower or 0 to 180 VDC, 2 horsepower
Current Limit	Selectable 4.0, 7.0, 10.0 and 12.0 Amps
Supply Power	115 VAC \pm 10% or 230 VAC \pm 10% Single Phase 50/60 HZ \pm 2HZ
Packaging	NEMA 1 or open chassis
Dimensions	15.0 Inches High 6.0 Inches Deep 10.0 Inches Wide
Operating Temperature	0 to 140 Degrees F
Humidity	0 to 95% RH, noncondensing

2.0 EQUIPMENT INSTALLATION

CAUTION!

Disconnect all electrical power to the E-Drive before attempting any installation or adjustment procedure.

2.1 MECHANICAL INSTALLATION

2.1.1 E-Drive Chassis Mounting

Mount the E-Drive so the front panel controls are readily accessible to the operator. Refer to Figure 2.1 for the mounting hole and chassis dimensions.

2.1.2 Sensor Installation

The sensors are required for a feedback of a signal representing motor speed or ext. ref. (lead) frequency. All cables from the sensor must be electrically shielded and physically located away from sources of electro-mechanical interference, i.e. motors, arc welder, etc.

The E-Drive will accept feedback signals from three types of sensors; 1) magnetic pickup and gear, 2) proximity switch and gear or 3) encoder.

The magnetic pickup is the most common. Fenner offers convenient kits to fit standard NEMA flanged motors. The sensor gap must be $.005 \pm .003$ inches.

2.2 ELECTRICAL INSTALLATION

The installation of this motor control system must conform to area or local electrical codes. For additional information refer to the National Electrical Code Article 430.

CAUTION!

If improper initial electrical connections are made and power is applied to the E-Drive, serious permanent damage to the control will result. Always double check all electrical connections before powering up. Refer to Fig 2-2.

2.2.1 Magnetic Pickup Connections

The sensor connections for the feedback and reference (lead) signals are shown in figure 2-2. The "J3" and "J4" shunt jumpers located above T1 on the E-Drive control board must be in "MAG" position.

2.2.2 Proximity and Encoder Connections

Proximity or encoder sensors can be used in place of magnetic pickups. Pin 7 of T1 provides a +10 volt DC power source for proximity devices requiring external power. The "J3" and "J4" shunt jumpers must be moved to the "LOGIC" position for proper operation.

2.2.3 Input Power

The DC voltage rating of the motor determines the input power requirements of the E-Drive. DC motors rated at 90VDC require 115 VAC input power to the E-Drive. DC motors rated at 180 VDC require 230 VAC input power to the E-Drive. Switch SW2 must show voltage connected.

2.2.4 Motor Connections

Connect the armature leads to terminals marked A1 and A2 on TB2. Reversal of the armature leads will reverse the direction of motor rotation.

Connect the field leads to terminals marked F1 and F2 on TB2. Permanent magnet (PM) motors do not require field connection.

2.2.5 Run/Stop Control

Run/Stop control for the E-Drive is accomplished by opening and closing the connection between the "Run/Stop" and common (TBI-4/5). Since an SCR drive may be subject to the problem of SCR misfire when AC input power is applied, especially on noisy 230V lines, the customer may choose to isolate the motor from the E-Drive by adding a contactor or correctly sized relay to the armature lines. In this case, an auxiliary contact must be used across the "Run/Stop" and COMMON terminals (TBI-4/5) that will close when the armature lines are opened by the main power contacts.

Figure 2-2 shows these RUN/STOP and contactor connections.

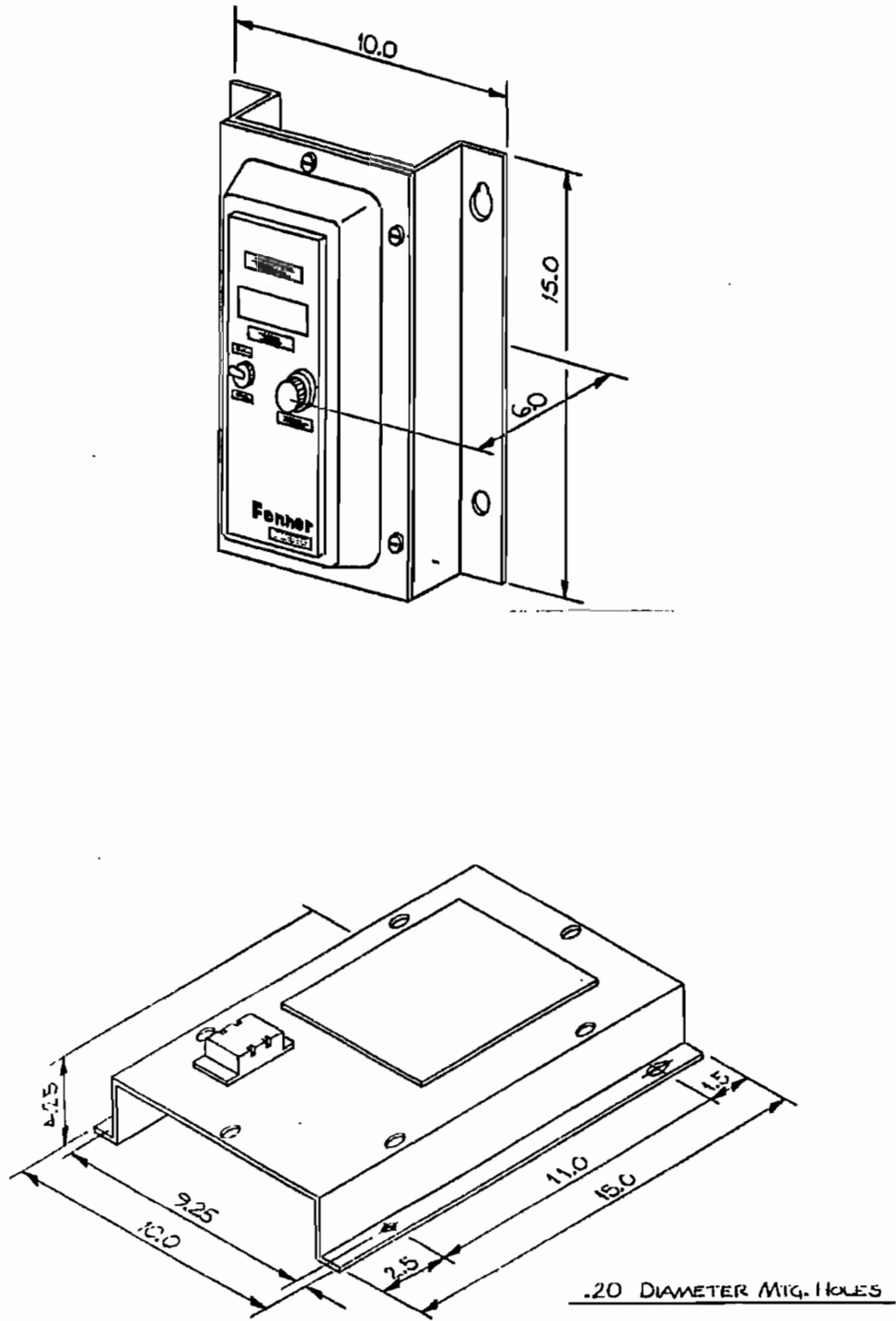
2.2.6 4 to 20 Milliamp Speed Set

A 4 to 20 milliamp control signal can be used in place of the speed set potentiometer to adjust the motor speed or ratio.

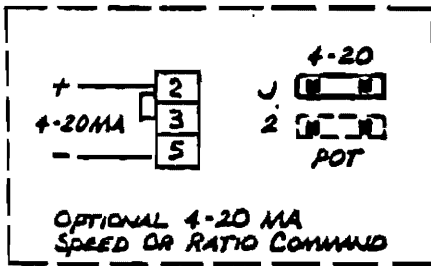
The "J2" shunt jumper located above TBI on the E-Drive control board must be moved to the "4-20" position.

2.2.7 Manual/Follower Mode Select

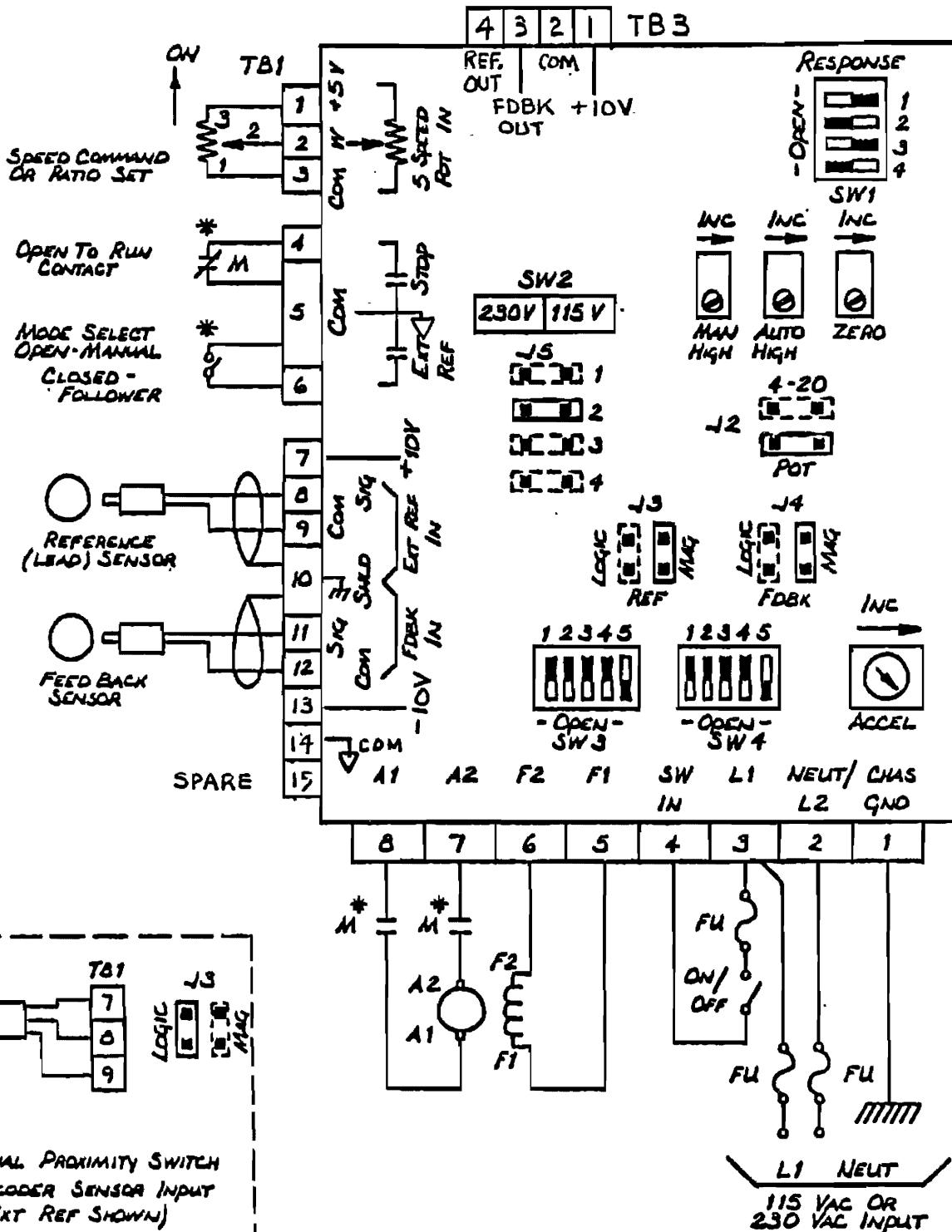
For tach follow operation, apply an external reference frequency (lead) signal at TBI-8 and enable this mode with a connection from Ext. Ref. TBI-6 to common TBI-5.



"Figure 2.1 - Mounting Dimensions."



E - DRIVE CONTROL BOARD



* OPTIONAL CUSTOMER SUPPLIED FEATURES

Figure 2-2

3.0 OPERATION AND ADJUSTMENTS

This section of the manual has been divided into two subsections, 1) Manual Mode and 2) Follower Mode.

3.1 MANUAL MODE

In the manual mode, the speed set potentiometer directly adjusts the motor speed.

3.1.1 Operation

Apply main power to the device, turn on the power switch and adjust the speed using the speed set potentiometer. The E-Drive will normally have an adjustable speed range of 0 to 2000 RPM (60 tooth sensing gear). It can be reprogrammed to other scale ranges. (See Par. 4.0)

3.1.2 Current Limit

The current limit adjustment selects the maximum output current permitted by the drive to the motor.

The following table indicated the J5 shunt position to be used for various motor ratings:

J5 SHUNT POSITION	HORSEPOWER	
	115 VAC	230 VAC
1	1/4	1/2
2*	1/2	1
3	3/4	1-1/2
4	1	2

Table 3-1 Current Limit Setting

* Factory normal setting

3.1.3 Accel/Decel

Turning the "ACCEL" pot in the clockwise direction will slow the acceleration and deceleration rate of response to a change in speed command.

3.1.4 Response

This adjustment should be changed if the motor control is unstable.

The response is changed by selecting various combinations of the "RESPONSE" switch, SW1. The control may be unstable with all the switch positions open or all closed. Try combinations of open and closed positions until the system is stable.

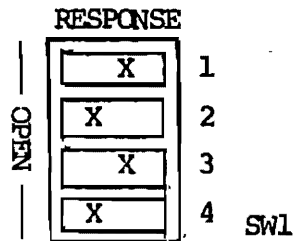


Figure 3-2 Response Switch Setting

3.1.5 Zero

The Zero adjustment sets the minimum speed, usually zero, that the control operates at with the speed command at zero speed.

3.1.6 Manual High Pot

This on-board adjustment pot calibrate the maximum speed when the operators speed pot is at 100%. If maximum speed is not within the range of 1800-2400 RPM or if the pulse generator does not yield 60 pulses per motor revolution, the unit must be reprogrammed. (See par. 4.0)

It may be necessary to readjust the zero setting after changing the manual high adjustment.

3.2 FOLLOWER MODE

In the follower mode, the motor speed follows the external reference frequency input at a ratio set by the operator's potentiometer.

3.2.1 Signals

Apply external reference signal (frequency) to TB1-8 and enable external reference mode by connecting TB1-6 to TB1-5.

3.2.2 Auto High Pot

This on-board adjustment pot calibrates the maximum speed when the operators ratio pot is at 100% and the external reference (lead) frequency is also at its maximum value. If the external frequency from the lead motor is not in the 1800-2400 PPS range (60 tooth sensing gear on 1800-2400 RPM motor) then the unit must be reprogrammed. See Par. 4.0.

4.0 REPROGRAMMING

The E-Drive can accommodate a wider range of external reference and feedback pulse rates (frequencies). This allows rise of sensing gears, encoders or other methods of generating signals other than the typical 60 tooth gear and magnetic pickup. Set up the range switches for manual operation (feedback) first. Then select range switch positions for the external reference frequency (lead if the unit will be operated in AUTO mode (tach follower)).

4.1 DETERMINE MAXIMUM SENSOR FREQUENCIES

All calculations deal with pulses-per-second (PPS) which is determined as follows:

$$\text{Frequency (PPS)} = \frac{\text{Maximum motor RPM} \times \text{Pulses per Rev}}{60}$$

4.2 SELECT SWITCH POSITIONS

Select switch combinations for the maximum sensor frequencies from the table 4-1. Set SW4 according to maximum feedback rates. Set SW3 according to maximum External Reference (lead) rates.

MAXIMUM FREQUENCY RATE (PPS)	SWITCH "ON" POSITIONS
2401 - 2700	1, 2, 3, 4, 5
1801 - 2400	1, 2, 3, 4 *
1401 - 1800	1, 2, 3
1101 - 1400	1, 4, 5
901 - 1100	3, 4, 5
751 - 900	2, 5
601 - 750	1
501 - 600	2
401 - 500	3
301 - 400	4
240 - 300	5

SW 3 or SW 4

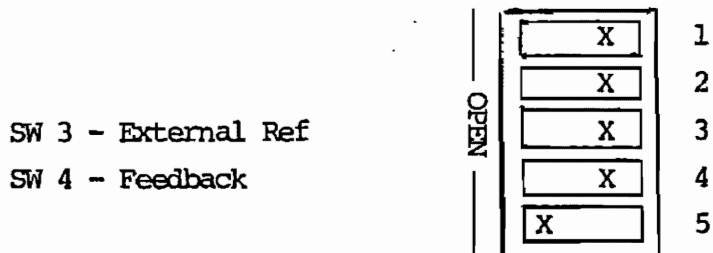


Table 4-1 Maximum Feedback Rate Settings

* Default Settings for 2000 PPS

4.3 RATIO POT NOT 100% AT MAX:

In Auto (tach follow) application the switch selections in section 4.2 presume max external signal, plus 100% ratio pot will call for max follower speed. In some cases where positive draw ratios or dancer arms are involved it may be desirable to have the ratio pot at less than 100% when lead and follow motors are at max or equal speeds.

- 4.3.1 In these cases, recalculate a new effective external reference rate which will be lower than actual. This new value will result in an offset on the pot setting, thus allowing matched lead and follow speeds with the pot or dancer arm at less than 100%.

$$\text{New Ext. Ref. Freq} = \text{ACTUAL MAX EXT REF} \times \text{POT}\%$$

Refer to table 4-1 and set this new value on SW 3.

- 4.3.2 If desired pot percent in 4.3.1 is around 50% or less you may experience fold-over (runs at 1/2 desired speed) when the external reference (lead) frequency gets near it's max value. In these cases shift both SW 3 and SW 4 upwards one or more ranges from their original ranges per table 4-1.

4.4 CALIBRATE POTS

After reprogramming the MANUAL high adjust and AUTO high adjust pots will need adjusting per par 3.1.6 and 3.2.2 respectively. The zero adjust pot may also need readjustment per par 3.1.5

4.5 DISPLAY ADJUSTMENTS

The Tach/Display is a true digital frequency counter with crystal time base. The Tach/Display is switch-programmable to allow read-out scaling in engineering units.

- 4.5.1 Time Base Adjustments
Calculate the display update time or time base using the following formula:

$$\text{TIME (SEC)} = \frac{\text{Desired Display Number}}{\text{Input Pulse Rate}}$$

Ignore the display decimal point in the above equation.

Example:

The desired readout is 23.40 ft/min when the motor is running at full speed, 1800 RPM. A 60 tooth gear is used.

$$\text{INPUT PULSE RATE} = \frac{1800 \text{ RPM} \times 60 \text{ Pulse / Rev}}{60} = 1800 \text{ PPS}$$

$$\text{TIME (SEC)} = \frac{2340}{1800} = 1.3 \text{ SECONDS}$$

If the Time Base is less than 0.8 sec, the Input Divide Switch SW2, must be changed to bring the time above 0.8 sec. Using the table below, select the smallest multiplier that will bring the time above 0.8 sec.

SWITCH POSITION	MULTIPLIER
* 1	X 1
2	X 2
3	X 4
4	X 8

* Factory Default Setting.

Table 4-1 SW2 Input Divide Switch
Refer to figure 4-4 for all switch position locations.

Now set the Time Base Select Switch, SW4. Select the Time Base Select Switch positions by repeated subtraction, using table below. First subtract a constant of .001 sec, then find the largest time in the table that can be subtracted and set its switch to on. Repeat until the remainder time is zero.

SWITCH POSITION	TIME CONSTANT (SEC.)
1	.001
2	.002
3	.004
4	.008
5	.016
6	.032
7	.064
8	.128
9	.256
10	.512
11	1.024
12	2.048

Table 4-2 SW4 Time Base Select Switch

Eg: From the previous example:
Time Base = 1.300 Sec.

1. 1.300 - .001 = 1.299 (Constant - No Switch)
2. 1.299 - 1.024 = 0.275 (Switch Pos. 11 - ON)
3. 0.275 - 0.256 = 0.019 (Switch Pos. 9 - ON)
4. 0.019 - 0.016 = 0.003 (Switch Pos. 5 - ON)
5. 0.003 - 0.002 = 0.001 (Switch Pos. 2 - ON)
6. 0.001 - 0.001 = 0.000 (Switch Pos. 1 - ON)

4.5.2 DECIMAL POINT

Switch 3, SW3, is used to set the decimal point of the readout using the table below set the desired decimal point.

SWITCH POSITION	DECIMAL POINT POSITION
0	None
1	XXX.X
2	XX.XX
3	X.XXX
4	.XXXX

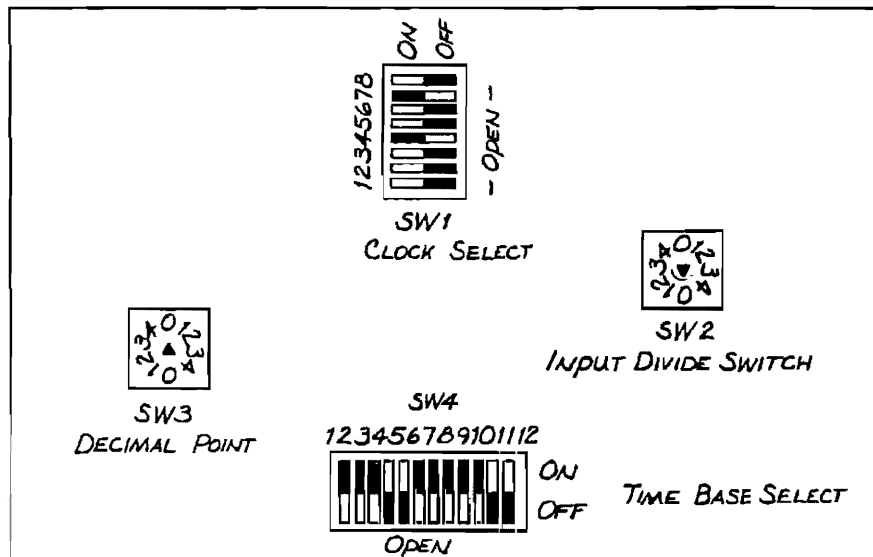
Table 4-3 SW3 Decimal Point Position

Example: The example of 23.40 ft/ min would use position 2 for the decimal point.

4.5.3 CRYSTAL CLOCK

Switch 1, SW1, is used to set the crystal clock frequency. Normally, Positions 4 and 7 must always be ON.

Consult the factory prior to making any changes to SW1.



DISPLAY/TACH BOARD SETTINGS

THE SWITCH POSITIONS SHOWN ABOVE ARE THE FACTORY POSITIONS FOR A DIRECT RPM READOUT WITH A 60 TEETH GEAR

FIGURE 4-4

5.0 TROUBLESHOOTING

PROBLEM	PROBABLE CAUSE	RECOMMENDED ACTION
<p>5.1a) Fuse blows when line power turned on. Line switching used to Start/Stop motor.</p>	<p>a) SCR block shorted.</p> <p>b) Possible SCR false fire (dv/dt) due to discontinuities in the input 230 VAC wave form.</p> <p>c) Mechanical bind on motor.</p> <p>d) Short in motor armature circuit.</p> <p>e) E-Drive not wired correctly.</p>	<p>a) Replace E-Drive assembly or SCR. See recommended spare parts.</p> <p>b) Install a motor relay to be used to start and stop the motor. Be sure NC contact is wired across TBl-4 & 5 to neutralize the control.</p> <p>c) Inspect all mechanical connections to the motor and insure free rotation.</p> <p>d) Remove A1 & A2 wires from terminal strip and OHM out.</p> <p>e) Check figure 2-2 for proper wiring</p>
<p>b) Fuse blows when the motor relay M is pulled in. (If used).</p>	<p>a) SCR block shorted.</p> <p>b) Neutralization contact across TBl-4 & 5 not wired or constant open.</p> <p>c) Mechanical bind on motor.</p> <p>d) Short in motor armature circuit.</p>	<p>a) Replace E-Drive assembly or SCR. See recommended spare parts.</p> <p>b) Power down, OHM out Run/Stop NC contact.</p> <p>c) Inspect to be sure motor can turn freely.</p> <p>d) Remove A1 and A2 from terminal strip and OHM out.</p>

PROBLEM	PROBABLE CAUSE	RECOMMENDED ACTION
5.2 Motor does not start.	<ul style="list-style-type: none"> a) No line voltage b) Fuse blown. c) Fuse not making proper contact in fuse clips. d) Armature leads not connected or are open in the motor. e) Ratio pot set at zero in follower mode or manual speed pot set at zero in manual mode. f) No lead frequency in the follower (Ext. Ref.) mode. g) Control PCB failure. 	<ul style="list-style-type: none"> a) Measure input line voltage b) Power down, measure fuse. See problem 5.1a and b. c) Power down and reset fuses. d) Verify by disconnecting A1 and A2 at the terminal strip and OHM out. When an armature relay M is used you can physically pull it in for continuity measurements. e) Check that DC voltage can be adjusted from 0 to 5 VDC at TBl-2 and use TBl-5 as a common on the assy. See figure 2.2 f) LED 1 should be lit or blink with lead frequency input. Start line or lead motor, verify an input signal. If a mag. pickup remove signal wires from TBl-8 and TBl-9 at the control card and measure 40 to 100 OHMS back out through the mag. pickup. If encoder or proximity switch make sure J3 is in logic position. g) Replace E-Drive.

PROBLEM	PROBABLE CAUSE	RECOMMENDED
<p>5.3 Motor runs maximum speed; no potentiometer speed control.</p>	<p>a) Magnetic pickup gap greater than specified.</p> <p>b) Magnetic pickup not connected to control PCB or wire broken or shorted.</p> <p>c) Magnetic pickup damaged or lead wire broken.</p>	<p>a) Adjust gap to $.005 \pm .003$ inches.</p> <p>b) LED 2 should be on or blink with feedback signal. Disconnect the magnetic pickup wires from TBl-11 and TBl-12 at the control card and measure 40 to 100 OHMS back through the magnetic pickup. If encoder or proximity switch is used, check to see that J4 is in the Logic position.</p> <p>c) Replace magnetic pickup or lead wire.</p>
<p>5.4 Speed control erratic at any given potentiometer setting.</p>	<p>a) Magnetic pickup bracket vibrating.</p> <p>b) Improper magnetic pickup gap.</p> <p>c) Motor brushes are worn or are glazed.</p> <p>d) Control PCB failure.</p> <p>e) Response select switch not set properly.</p> <p>f) In and out of current limit, as seen by LED 3 turning on and off.</p> <p>g) Lead signal pulse rate too low (less than 45HZ) and ratio pot set at a low % factor.</p> <p>h) Erratic lead signal.</p>	<p>a) Replace with a sturdy bracket.</p> <p>b) Adjust for $.005 \pm .003$ inch gap.</p> <p>c) Replace brushes or sand brushes using fine sand paper.</p> <p>d) Replace E-Drive.</p> <p>e) Set active lead response select switch per section 3.1.4.</p> <p>f) Increase current limit by changing J5 shunt. Check for proper motor size.</p> <p>g) Follower motor must run from 45 to 90 RPM as a minimum with a steady state load for smooth operation.</p> <p>h) The lead frequency must be smooth and stable.</p>

PROBLEM	PROBABLE CAUSE	RECOMMENDED ACTION
5.5 Speed Commanded and actual motor speed desired is in error but speed does change with pot settings.	<ul style="list-style-type: none"> a) Improper speed control scale factor set on SW3 and/or SW4. b) Improper gear used for feedback signal. c) Power switch set to wrong voltage. 	<ul style="list-style-type: none"> a) Consult section 4.0 of manual. b) Mount the correct gear. c) Set power switch to correct voltage input.
<ul style="list-style-type: none"> 5.6 a) Motor lurches when AC power applied. b) Motor lurches when M contactor (if used) is energized. Power was previously applied. 	<ul style="list-style-type: none"> a) SCR fires when 230 VAC power applied. b) No neutralization across TB1-4 & 5. Armature voltage of E-Drive at maximum value when "M" relay is closed. 	<ul style="list-style-type: none"> a) Use motor relay "M" for Start/Stop and NC contact across TB-4 & 5 for control neutralization. b) Install neutralization contact across TB-4 & 5 to assure armature voltage is at 0 volts when the armature relay "M" is pulled in.
UNITS HAVING DISPLAYS:		
<ul style="list-style-type: none"> 5.7 a) No display (DARK) or All Digits zero. Motor does run. b) No display (DARK) or All Digits zero. Motor doesn't run. 	<ul style="list-style-type: none"> a) Cable disconnected at display or control PCB. b) Bad display board logic. a) Fuse blown. b) E-Drive board bad. 	<ul style="list-style-type: none"> a) Connect cable to display. b) Replace Display board. a) Replace 12 amp fuse or 3/8 amp. Slow blow fuse. b) Replace E-Drive PCB.

PROBLEM	PROBABLE CAUSE	RECOMMENDED ACTION
5.8 Display indicates only 7777 or another random number- does not change.	<ul style="list-style-type: none"> a) Clock circuit inoperative. b) SW1 switch on wrong position. 	<ul style="list-style-type: none"> a) Replace display board. b) SW1 pos. 7 and one other position (usually 4) must be "ON".
5.9 Display indicates wrong speed but motor speed is correct.	<ul style="list-style-type: none"> a) Display program is wrong. b) Display board failure. c) Wrong clock input selected. (SW1). 	<ul style="list-style-type: none"> a) Check for proper programming in section 4.0. b) Replace display. c) Change clock input. SW1. (Usually #4 & #7 are "ON").

6.0 SPARE PARTS LIST

Fenner Industrial Controls maintains an active Quality Assurance Department to check over products before they go into the field. Because of this check Fenner Industrial Controls has minimal problems on start up.

Controls in use, however, are subject to misuse, accidents, and component failure. Because of this we advise that the system have a spare parts backup in case of failure.

Suggested parts are listed below:

1) E-Drive Control board	9000-3030
2) Display board	9000-3080
3) SCR block	6003-5020
4) 12 Amp fuse	6441-0314
5) 3/8 Amp fuse	6441-0117
6) Mag Sensor	
SM3N - Threaded	5800-1410
SM3NA- Non-Threaded	5800-1412

PROGRAMMING DATA E-DRIVE

A. Scale Factor-Manual Mode

- 1 Speed Pot Range 05.0% to 100.0%
- 2 Speed Max. 2000 pps at 100.0%
Min. 100 pps at 05.0%
- 3 Feedback sensor 60 Pulses/Rev
- 4 Switch 4 pos. 1234 ON (Feedback Program)

B. Scale Factor-Auto Mode (Optional)

- 1 Ratio Pot Range 05.0% to 100.0%
- 2 Follower Speed Max. 2000 pps at 100.0%
Min. 100 pps at 05.0% } WITH EXT. REF (LEAD) AT 2000 PPS
- 3 Feedback sensor 60 Pulses/Rev
- 4 Switch 4 pos. 1234 ON (Feedback Program)
- 5 Lead Freq. 2000 HZ at Max. ratio pot and max. F.B. pps
- 6 Switch 3 pos. 1234 ON (Lead Program)

C. Display Factor (Optional)

- 1 Display 2000 at 2000 pps
- 2 Program Count 1.000 SEC Div. Factor SW 2 pos / Dec. Point SW 3 pos. 0
- 3 SW4 "ON" Pos 123678910

D. Voltage input/current limit

- 1 Voltage select (SW2) 115VAC 230VAC
- 2 HP-Shunt Select

1		1/4HP	1/2HP
2	X	1/2HP	1 HP
3		3/4HP	1½ HP
4		1 HP	2 HP

E. Sensor Input

- 1 Feedback Mag Logic
- 2 Lead Mag Logic

- F. Response select (SW1)

1	2	3	4
X		X	

 ON

G. Max. Feedback or Lead Range in PPS

- 1801 - 2400
- 1401 - 1800
- 1101 - 1400
- 901 - 1100
- 751 - 900
- 601 - 750
- 501 - 600
- 401 - 500
- 301 - 400
- 241 - 300

Select SW #4 or #3 Pos. ON

- | | | | |
|---|---|---|---|
| 1 | 2 | 3 | 4 |
| 1 | 2 | 3 | 4 |
| 1 | 4 | 5 | 5 |
| 3 | 4 | 5 | 5 |
| 2 | 5 | 5 | 5 |
| 1 | 5 | 5 | 5 |
| 2 | 5 | 5 | 5 |
| 3 | 5 | 5 | 5 |
| 4 | 5 | 5 | 5 |
| 5 | 5 | 5 | 5 |

Fenner INDUSTRIAL CONTROLS, INC. MINNEAPOLIS, MN. - U.S.A.		TITLE STANDARD FACTORY PROGRAM 2000 RPM - (MANUAL) 100 % FOLLOW RATIO - (AUTO) RPM DISPLAY 60T GEAR W/ MAG. PICK-UP		
Drawn by		SCALE SHEET DWG. NO. REV		
Checked by				
Project Engr				
		_____ of _____		

service policy

Contrex, Inc., recognizes that with each sale of its product there are certain product obligations. This document defines the limits of such obligations and provides guidelines for the performance of related services.

Applicability

This Service Policy shall apply to all product sales of Contrex, Inc. However, it may be modified by mutual consent. Thus, whenever an accepted proposal contains wording inconsistent with this policy, the proposal will prevail with respect to specific sale or series of sales involved.

Applicability of this policy is also somewhat limited in cases where products are sold to an OEM for resale to user. See paragraph below entitled *OEM Service*.

Service Personnel

Contrex, Inc., has a staff whose primary responsibility is service - both factory service and field (on-site) service. Personnel of this department are usually available for service on a 24 hour notice. To facilitate quicker handling of service requests, either written or by phone, such requests should be directed to the Contrex, Inc., Technical Services Department.

Service Charges

Contrex, Inc., reserves the right to charge for all services performed at the customers request with the exception of factory service performed under warranty. All on-site service is charged at flat-rate per diem rates plus expenses. Any Contrex, Inc., product developing defects as defined in the warranty during its effective period will be repaired or replaced without charge, providing it is shipped, prepaid, to Contrex, Inc., 8900 Zachary Lane North, Maple Grove, Minnesota 55369.

Spare Parts

Contrex, Inc., will usually have an adequate inventory of spare parts and circuit boards for all standard products. However, purchasers are encouraged to maintain a nominal supply of spare parts to insure immediate on-site accessibility.

Instruction Manuals

Instructions for installation, maintenance and troubleshooting are included in manuals that are provided with the equipment. Repairs may be performed in the field by competent customer personnel; but in order to not invalidate the warranty they must be made in strict accordance with published instructions, and **ONLY AFTER** obtaining approval of the Technical Service Department (such repairs are usually limited to the replacement of circuit boards and major subassemblies, not the repair of these items).

OEM Service

In many instances Contrex, Inc., products are sold to the original equipment manufactures or integrators for inclusion in larger systems. In such cases the obligations of Contrex, Inc., extend only to that original purchaser. It is the latter's responsibility to handle any service required by his customer, the end user. Such problems can usually be solved by field replacement of complete units. OEM's are encouraged to buy and maintain a supply of "loaners" for this purpose. Contrex, Inc., will provide factory overhaul service at nominal charges to support that OEM. Users of Contrex, Inc., products that were acquired as components of larger systems may buy service or spare parts directly from Contrex, Inc., at standard prices, but they must appeal through the OEM for warranty service.

If Contrex, Inc., encounters trouble in the field which appears to be the result of fault or inadequacy of the system, Contrex, Inc., reserves the right to recover service charges from the party that authorized the service activity.



warranty

Contrex, Inc., guarantees this device against defects in workmanship and materials for a period of one (1) year from the date of purchase. Any parts or components that fail during the warranty period will be replaced or repaired without charge. This guarantee is void if the device has been damaged by improper installation or operation, tampering, careless handling or accident.

When a device fails to function in accordance with standards set forth in the instruction manual, the purchaser should contact an authorized representative of Contrex, Inc., 8900 Zachary Lane North, Maple Grove, Minnesota 55369. Whether repairs will take place in the field or at the factory will be solely the prerogative of Contrex, Inc.

If inspection reveals defects that are caused by faulty materials or workmanship, Contrex, Inc., reserves the right to either replace the device or rebuild the device using new or refurbished warranted parts and components. In either instance, the device that is returned to the purchaser meets full factory standards for new device performance. If there is less than 90 days remaining on the warranty period at the time of the repair, the warranty will extend to 90 days after the repair.

Parts and services outside the scope of this warranty will be available at Contrex, Inc., current market price.

Contrex's liability for a device or its use, whether in warranty or not, shall not in any instance exceed the cost of correcting the defects of the device. Contrex, Inc., assumes no responsibility for damage to property or injuries to persons from improper use of this device.

No express warranties and no implied warranties whether of merchantability or otherwise (except as to title), other than those set forth above, which are expressly made in lieu of all other warranties, shall apply to any device sold by Contrex, Inc.

Contrex, Inc., reserves the right to change or improve its devices without imposing any obligation upon Contrex, Inc., to make changes or improvements in previously manufactured devices.

This warranty statement is a summary of Contrex, Inc's policy. Further limits of liability are contained in the Contrex, Inc's purchase order acknowledgments and invoices.



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